

## CLAIMS

1. A method for generating hydrogen gas which comprises decomposing a metal hydride represented by the formula (1) below in a mixture composed of said metal hydride, water, and a second solution which has a pH value lower than that of the aqueous solution of said metal hydride.

Formula (1) :  $\alpha_{z(1-x)}\beta_{zx}[\text{BH}_y]$

(where  $\alpha$  and  $\beta$  are mutually different elements selected from Groups 1A, 2A, and 2B of the periodic table; and  $x$ ,  $y$ , and  $z$  are defined respectively by  $0 \leq x \leq 1$ ,  $3 < y < 6$ , and  $0 < z < 3$ .)

2. The method for generating hydrogen gas as defined in Claim 1, wherein  $\alpha$  and  $\beta$  each represents an element selected from Li, Na, K, Mg, Ca, and Zn.

3. The method for generating hydrogen gas as defined in Claim 1, wherein an aqueous solution of the metal hydride represented by the formula (1) above is incorporated with a second aqueous solution which has a lower pH value than said aqueous solution of said metal hydride.

4. The method for generating hydrogen gas as defined in Claim 3, wherein the aqueous solution of the metal hydride and the second aqueous solution are mixed together for reaction continuously at a constant ratio.

5. The method for generating hydrogen gas as defined in Claim 1, wherein the aqueous solution of the metal hydride has a pH value higher than 7 and the second aqueous solution has a pH value lower than 7.

6. The method for generating hydrogen gas as defined

in Claim 1, wherein the second solution is an acid in the form of liquid or an aqueous solution of an acid.

7. The method for generating hydrogen gas as defined in Claim 6, wherein the second solution is an acidic aqueous solution of an inorganic acid or an organic acid.

8. An apparatus for producing hydrogen gas which comprises a first reservoir for storage of an aqueous solution of a metal hydride represented by the formula (1) below, a second reservoir for storage of a second solution which has a pH value lower than that of the aqueous solution of said metal hydride, and a reactor to mix together the aqueous solution of said metal hydride and said second solution, thereby generating hydrogen gas.

Formula (1) :  $\alpha_{z(1-x)}\beta_{zx}[\text{BH}_y]$

(where  $\alpha$  and  $\beta$  are mutually different elements selected from Groups 1A, 2A, and 2B of the periodic table; and  $x$ ,  $y$ , and  $z$  are defined respectively by  $0 \leq x \leq 1$ ,  $3 < y < 6$ , and  $0 < z < 3$ .)

9. The apparatus for producing hydrogen gas as defined in Claim 8, wherein  $\alpha$  and  $\beta$  each represents an element selected from Li, Na, K, Mg, Ca, and Zn.

10. The apparatus for producing hydrogen gas as defined in Claim 8, wherein the aqueous solution of the metal hydride has a pH value higher than 7 and the second aqueous solution has a pH value lower than 7.

11. The apparatus for producing hydrogen gas as defined in Claim 8, wherein the second solution is an acid in the form of liquid or an aqueous solution of an acid.

12. The apparatus for producing hydrogen gas as defined in Claim 10, wherein the second solution is an acidic aqueous solution of an inorganic acid or an organic acid.

13. The apparatus for producing hydrogen gas as defined in Claim 8, wherein the first reservoir and the second reservoir each is connected to the reactor.

14. The apparatus for producing hydrogen gas as defined in Claim 8, which has a mechanism by which the aqueous solution of the metal hydride and the second aqueous solution are mixed together for reaction continuously at a constant ratio.

15. The apparatus for producing hydrogen gas as defined in Claim 8, wherein the first reservoir and the second reservoir are constructed such that they are completely filled at all times with the aqueous solution of the metal hydride and the second solution.

16. The apparatus for producing hydrogen gas as defined in Claim 15, wherein the first reservoir has an aqueous solution container which is made of an alkali-resistant flexible material and the second reservoir has a liquid container made of an acid-resistant flexible material.

17. The apparatus for producing hydrogen gas as defined in Claim 16, wherein the internal container as the aqueous solution container of the first reservoir is installed in an alkali-resistant external container, and the internal container as the liquid container is installed in an acid-resistant external container.

18. The apparatus for producing hydrogen gas as de-

defined in Claim 17, wherein the space between the internal container of the first reservoir and the external container is filled with a substance which cures upon reaction with the alkaline aqueous solution, and the space between the internal container of the second reservoir and the external container is filled with a substance which cures upon reaction with the acidic aqueous solution.

19. The apparatus for producing hydrogen gas as defined in Claim 13, which has a flow regulator placed between the reactor and the first reservoir or the second reservoir or both.

20. The apparatus for producing hydrogen gas as defined in Claim 19, which has a pressure sensor to detect the internal pressure of the reactor and a controller to regulate the action of the regulator in response to the value detected by the pressure sensor.

21. The apparatus for producing hydrogen gas as defined in Claim 8, wherein the hydrogen gas is discharged from the reactor.

22. The apparatus for producing hydrogen gas as defined in Claim 8, wherein the first reservoir and the second reservoir each has a safety valve to keep the internal pressure below a prescribed value.

23. The apparatus for producing hydrogen gas as defined in Claim 22, wherein the safety valve for the first reservoir and the safety valve for the second reservoir are installed such that the gas pressure applies in the mutually opposite direction.

24. The apparatus for producing hydrogen gas as defined in Claim 8, which has a waste liquid reservoir to store waste liquid discharged from the reactor.

25. The apparatus for producing hydrogen gas as defined in Claim 17, wherein the waste liquid that has occurred in the reactor is introduced into and stored in the space between the external container and the internal container of the first reservoir and/or the second reservoir.

26. The apparatus for producing hydrogen gas as defined in Claim 8, wherein the first reservoir and the second reservoir are of concentric dual-pipe or multi-pipe structure connected to the reactor.

27. The apparatus for producing hydrogen gas as defined in Claim 26, wherein the pipe structure to store the waste liquid from the reactor is of concentric dual-pipe or multi-pipe structure.

28. The apparatus for producing hydrogen gas as defined in Claim 26, wherein the space between the first reservoir and the second reservoir is filled with a substance which cures upon reaction with the alkaline aqueous solution and/or the acidic aqueous solution.

29. The apparatus for producing hydrogen gas as defined in Claim 8, wherein the reactor is provided with a mechanism to separate hydrogen gas.

30. The apparatus for producing hydrogen gas as defined in Claim 29, wherein the reactor is connected to a porous pipe which is permeable to hydrogen gas and impermeable to liquid, the reaction to evolve hydrogen gas takes

place in the reactor and/or the porous pipe, and the mixture of the evolved hydrogen gas and the aqueous solution passes through the porous pipe so that only hydrogen gas permeates through the porous pipe and the hydrogen gas is separated from the aqueous solution.

31. The apparatus for producing hydrogen gas as defined in Claim 8, wherein the reactor is composed of a liquid introducing part and a water-absorbent part connected thereto, and the aqueous solution of the metal hydride and the second solution are introduced into the liquid introducing part for reaction, and the aqueous solution is absorbed by the water-absorbent part.

32. The apparatus for producing hydrogen gas as defined in Claim 31, wherein the liquid introducing part and the water-absorbent part are adjacent to each other.

33. The apparatus for producing hydrogen gas as defined in Claim 31, wherein the water-absorbent part has a space formed therein, and the aqueous solution of the metal hydride and the second solution are supplied to the space through the water-absorbent part.

34. The apparatus for producing hydrogen gas as defined in Claim 8, which has a control mechanism to regulate the flow rate of the aqueous solution of the metal hydride and the second solution which are supplied to the reactor.

35. The apparatus for producing hydrogen gas as defined in Claim 34, wherein the pipe to supply the aqueous solution of the metal hydride to the reactor and the pipe to supply the second solution to the reactor differ in

diameter from each other.

36. The apparatus for producing hydrogen gas as defined in Claim 34, wherein the control mechanism has a pressure-displacement conversion element.

37. The apparatus for producing hydrogen gas as defined in Claim 36, wherein the control mechanism is a pressure-displacement conversion element of diaphragm type.

38. The apparatus for producing hydrogen gas as defined in Claim 15, wherein the containers for the aqueous solution of the metal hydride and the second solution each has a movable wall in contact with the inside thereof to push out the aqueous solution or the second solution.

39. The apparatus for producing hydrogen gas as defined in Claim 38, wherein the movable wall is energized in one direction by an elastic means attached to one side thereof so that the aqueous solution or the second solution is continuously pushed out.

40. The apparatus for producing hydrogen gas as defined in Claim 38, wherein the movable wall constitutes a piston of a syringe.

41. The apparatus for producing hydrogen gas as defined in Claim 39, wherein the waste liquid discharged from the reactor is stored in the space which accommodates the elastic means.

42. An energy conversion system which comprises a hydrogen gas generating apparatus and an energy converting apparatus to convert the hydrogen gas produced by said hydrogen gas generating apparatus into electrochemical

energy, said hydrogen gas generating apparatus having a first reservoir for storage of an aqueous solution of a metal hydride represented by the formula (1) below, a second reservoir for storage of a second solution which has a pH value lower than that of the aqueous solution of said metal hydride, and a reactor to mix together the aqueous solution of said metal hydride and said second solution, thereby generating hydrogen gas.

Formula (1) :  $\alpha_{z(1-x)}\beta_{zx}[\text{BH}_y]$

(where  $\alpha$  and  $\beta$  are mutually different elements selected from Groups 1A, 2A, and 2B of the periodic table; and  $x$ ,  $y$ , and  $z$  are defined respectively by  $0 \leq x \leq 1$ ,  $3 < y < 6$ , and  $0 < z < 3$ .)

43. The energy conversion system as defined in Claim 42, wherein the hydrogen gas generating apparatus is one which is defined in any of Claims 9 to 41.

44. The energy conversion system as defined in Claim 42, which has a mechanism to supply heat evolved by the reactor to the energy conversion apparatus.

45. The energy conversion system as defined in Claim 42, which has a mechanism to supply water evolved by the energy conversion apparatus to the hydrogen gas generating apparatus.

46. The energy conversion system as defined in Claim 42, wherein the energy conversion apparatus is united with the reactor.

47. The energy conversion system as defined in Claim 42, wherein the energy conversion apparatus is a fuel cell.



48. The energy conversion system as defined in Claim 42, wherein an electrochemical energy conversion means composed of a hydrogen electrode, an ion conductor, and an oxygen electrode is connected to the reactor.

49. The energy conversion system as defined in Claim 48, wherein the reactor is held between a pair of the electrochemical energy conversion means.